CUA Guideline: Management of Ureteral Calculi

Jason Y. Lee, Sero Andonian, Naeem Bhojani, Jennifer Bjazevic, Ben H. Chew, Shubha De, Hazem Elmansy, Andrea G. Lantz-Powers, Kenneth T. Pace, Trevor D. Schuler, Rajiv K. Singal, Peter Wang, Michael Ordon

Originally published in *Can Urol Assoc J 2021;15(12):E*676-90 .
http://dx.doi.org/10.5489/cuaj.7581

Disclosures

Dr. Lee has received a speaker honorarium from Baxter.

Dr. Bhojani has reviewed new products for Boston Scientific and participated in WATER 2, an Aquablation multi-institutional clinical trial supported by Procept.

Dr. Chew has been a consultant for Auris Robotics, Bard Medical, Boston Scientific, and Olympus; has been a lecturer for Boston Scientific, Coloplast, Cook Medical, and Olympus; received a study grant from Boston Scientific; received a fellowship salary from Cook Medical; and participated in clinical trials supported by Boston Scientific and Cook Medical.

Dr. Elmansy has received payment from Boston Scientific, Clarion Medical Technologies/AccuTech Medical Technologies, and Janssen; and received speaker honoraria and a travel grant from Lumenis.

Dr. Pace has received support for a fellowship and annual lectureship from Cook Urological.

The remaining authors report no competing personal or financial interests related to this work.

Urolithiasis

Platinum Priority – Stone Disease

Editorial by Brian R. Matlaga on pp. 166–167 of this issue

Prevalence of Kidney Stones in the United States

Charles D. Scales Jr.[a,b,*], *Alexandria C. Smith*[c], *Janet M. Hanley*[c], *Christopher S. Saigal*[a,c], *Urologic Diseases in America Project*

Table 1 – Weighted (unadjusted) percent prevalence of stone disease by population characteristic

Characteristic	History of kidney stones, % (95% CI)		History of passing at least one kidney stone, % (95% CI)	
	Male	Female	Male	Female
Age group, yr				
20–29	3.4 (2.1–4.7)	3.4 (2.2–4.7)	3.3 (2.0–4.5)	2.5 (1.3–3.7)
30–39	6.9 (5.0–8.8)	5.9 (4.5–7.2)	6.5 (4.6–8.5)	5.0 (3.5–6.4)
40–49	9.8 (7.3–12.3)	7.6 (5.6–9.5)	8.1 (5.9–10.4)	6.4 (4.7–8.1)
50–59	13.1 (10.3–15.9)	8.1 (5.9–10.3)	11.1 (13.4–19.3)	6.9 (4.8–9.0)
60–69	19.1 (15.9–22.4)	9.4 (6.6–12.2)	16.3 (13.4–19.3)	8.4 (5.6–11.3)
70+	18.8 (16.5–21.0)	9.4 (7.5–11.3)	16.0 (13.8–18.3)	7.1 (5.5–8.8)
All ages	10.6 (9.4–11.9)	7.1 (6.4–7.8)	9.2 (8.1–10.3)	5.9 (5.2–6.6)

CI = confidence interval.

Table 4 – Multivariable regression model predicting history of kidney stones

Characteristic	Odds ratio (95% CI)	*p* value
Age, yr		
20–39	1.00 (referent)	–
40–59	1.83 (1.3[illegible]–2.45)	<0.001
≥60	2.18 (1.7[illegible]–2.73)	<0.001
Female	0.63 (0.5[illegible]–0.75)	<0.001
Race		
White, non-Hispanic	[illegible] (referent)	–
Black, non-Hispanic	0.37 (0.28–0.49)	<0.001
Hispanic	0.60 (0.49–0.73)	<0.001
Other/multiracial	0.57 (0.37–0.89)	0.014
BMI category		
Normal	1.00 (referent)	–
Overweight	1.29 (0.96–1.[illegible]2)	0.0875
Obese	1.55 (1.25–1.[illegible]4)	<0.001
Household income, $		
≥75 000	1.00 (referent)	–
35 000–74 999	1.49 (1.16–1.92)	0.002
20 000–34 999	1.65 (1.27–2.15)	<0.001
0–19 999	1.[illegible] (1.17–2.09)	0.002
Diabetes	1.59 (1.22–2.[illegible]07)	<0.001
Gout	1.92 (1.44–2.[illegible]6)	<0.001

CI = confidence interval; BMI = body [illegible] index.

Urolithiasis

Original article

The Changing Incidence and Presentation of Urinary Stones Over 3 Decades

Wonngarm Kittanamongkolchai MD [a], Lisa E. Vaughan MS [b], Felicity T. Enders PhD [b], Tsering Dhondup MBBS [a], Ramila A. Mehta MS [b], Amy E. Krambeck MD [f], Cynthia H. McCollough PhD [d], Terri J. Vrtiska MD [d], John C. Lieske MD [a, c], Andrew D. Rule MD [a, e]

Mayo Clinic Proceedings
Volume 93, Issue 3, March 2018, Pages 291-299

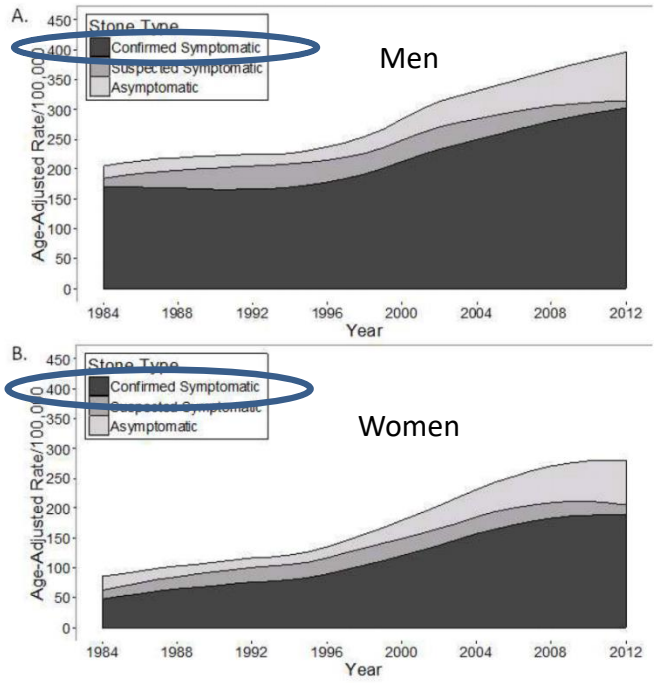


Figure 2.
A and B. Trends in the incidence of kidney stone formers (confirmed symptomatic, suspected symptomatic, and asymptomatic) from 1984 to 2012 in Olmsted County, Minnesota among A) men and B) women.

Methodology

- PubMed/Medline publications, focus on 2000–2020
- 2011 Oxford Centre for EBM Levels of Evidence

CEBM Centre for Evidence-Based Medicine UNIVERSITY OF OXFORD

Level of evidence	Description
Level I	Systematic review of randomised trials or *n*-of-1 trials
Level II	Randomised trial or observational study with dramatic effect
Level III	Non-randomised controlled cohort/follow-up study
Level IV	Case–series, case–control or historically controlled studies
Level V	Mechanism-based reasoning

Conservative management

- **Many patients with ureteral stones can initially be managed non-operatively, as spontaneous passage rates are high**, particularly for smaller stones (<5 mm) *(level 2, strong recommendation).*

Table 2. Patient outcomes by treatment group.

Endpoint	Tamsulosin	Placebo	% Difference (95% CI)
All patients	(n=198)	(n=195)	
No follow-up CT or intervention	32 (16.2)	32 (16.4)	−0.2 (−7.6 to 7.1)
Urologic intervention*	5 (2.5)	8 (4.1)	−1.6 (−5.1 to 2.0)
Follow-up CT	161 (81.3)	[illegible]	1.8 (−6.0 to 9.7)
Stone passage on CT, No. (%)	140 (87.0)	127 (81.9)	5.0 (−3.0 to 13.0)
Small stones (<5 mm)	(n=148)	[illegible]	
No follow-up CT or intervention	22 (14.9)	24 (16.9)	−2.0 (−10.5 to 6.4)
Urologic intervention	1 (0.7)	4 (2.8)	−2.1 (−5.2 to 0.9)
Follow-up CT	125 (84.5)	114 (80.3)	4.2 (−4.6 to 12.9)
Stone passage on CT, No. (%)	110 (88.0)	102 (89.5)	−1.5 (−9.5 to 6.5)
Large stones (5–10 mm)	(n=50)	(n=53)	
No follow-up CT or intervention	10 (20.0)	8 (15.1)	−4.9 (−9.8 to 19.6)
Urologic intervention	4 (8.0)	4 (7.6)	−0.5 (−9.9 to 10.8)
Follow-up CT or intervention	36 (72.0)	[illegible]	−5.3 (−22.1 to 11.4)
Stone passage on CT, No. (%)	30 (83.3)	25 (61.0)	22.4 (3.1 to 41.6)

*Patients undergoing urologic intervention did not have a CT performed at 28 days.

Table 2 – Patient outcomes by treatment group

Outcome	Tamsulosin	Placebo	Difference (95% CI)	p value
All patients	(n = 1642)	(n = 1654)		
Stone expulsion rate, N (%)	1419 (86)	1300 (79)	7.8 (5.2–10.4)	<0.001
Average stone expulsion time (h)	148.3 ± 63.2	[illegible]	−100.4 (−105.2 to −95.6)	<0.001
Average dosage of diclofenac (mg)	86 ± 32	236 ± 62	−150 (−153 to −147)	<0.001
Rate of pain relief therapy, N (%)	31 (1.9)	155(9.4)	−7.5 (−9.1 to −5.9)	<0.001
Side effect, N (%)	92 (5.6%)	84 (5.1%)	0.52 (−1.0 to 2.1)	0.5
Small stones (≤5 mm)	(n = 555)	(n = 561)		
Stone expulsion rate, N (%)	488 (88)	486 (87)	1.3 (−2.6 to 5.2)	0.5
Average stone expulsion time (h)	139.9 ± 68.9	147.1 ± 77.5	−7.20 (−15.80 to 1.40)	0.10
Average dosage of diclofenac (mg)	72 ± 31	168 ± 56	−95 (−100 to −90)	<0.001
Rate of pain-relief therapy, N (%)	6 (1.1)	40 (7.1)	−6.05 (−8.38 to −3.72)	<0.001
Side effect, N (%)	19 (3.5)	18 (3.2)	0.21 (−1.89 to 2.32)	0.8
Large stones (>5 mm)	(n = 1087)	(n = 1093)		
Stone expulsion rate, N (%)	931 (87)	814 (75)	11.17 (7.82–14.53)	<0.001
Average stone expulsion time (h)	152.5 ± 64.3	[illegible]	−147.0 (−153.1 to −140.1)	<0.001
Average dosage of diclofenac (mg)	93 ± 35	270 ± 72	−177 (−182 to −172)	<0.001
Rate of pain relief therapy, N (%)	25 (2.3)	115 (11)	−8.22 (−10.28 to −6.16)	<0.001
Side effect, N (%)	73 (6.7)	66 (6.0)	0.68 (−1.37 to 2.73)	0.5

CI = confidence interval; OR = odds ratio, SD = standard deviation; WMD = weighted mean difference.
Data are mean (SD), number (%), WMD (95% CI), and OR (95% CI).

Conservative management

- Obstructive pyelonephritis requires early goal-directed therapy, including timely decompression in an antegrade or retrograde fashion, **whichever method is most expedient** *(level 2, strong recommendation).*

TABLE 3. *Clinical outcomes*

	Overall	Percutaneous Nephrostomy	Retrograde Ureteral Catheterization	p Value
No. pos. urine culture (%):				
Before drainage	16 (38.1)	11 (52.4)	5 (23.8)	Not significant*
After drainage, 40 pts.	17 (40.5)	13 (62.9)	4 (19.1)	0.01*
No. pos. blood culture (%)	9 (22.5)	4 (20)	5 (25)	Not significant†
Mean ± SD days to normal WBC, 26 pts.	1.8 ± 1.0	2.0 ± 1.2	1.7 ± 0.8	Not significant‡
Mean ± SD days to normal temperature, 35 pts.	2.5 ± 1.8	2.3 ± 1.5	2.6 ± 2.1	Not significant‡
Mean ± SD days to normal temperature and WBC, 39 pts.	2.5 ± 1.7	2.6 ± 1.4	2.4 ± 2.0	Not significant‡
Mean ± SD days of stay	3.9 ± 3.3	4.5 ± 3.7	3.2 ± 2.8	Not significant§

* Chi-square test.
† Fisher's exact test.
‡ Mann-Whitney rank sum test.
§ Student's 2-tailed t test.

Conservative management

- The role of medical expulsive therapy in promoting spontaneous passage is controversial, but the current literature suggests if there is any benefit, it is for **larger (5–10 mm) ureteral (distal) stones** *(level 1, strong recommendation).*

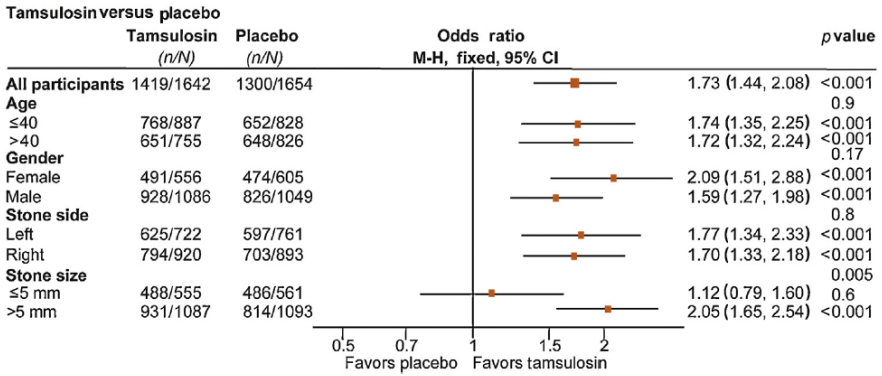
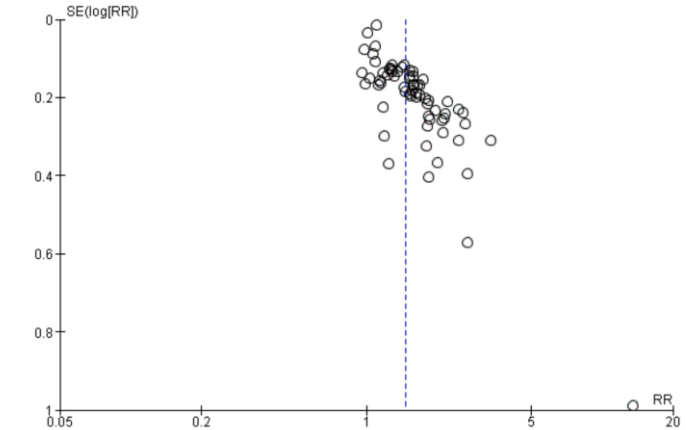


Figure 4. Funnel plot of comparison: 1 Alpha-blocker versus standard therapy or placebo, outcome: 1.1 Stone clearance.



Conservative management

- Forced intravenous hydration for the purposes of stone expulsion is not recommended *(level 1, moderate recommendation).*
- The use of **opioid-sparing analgesic regimens** has been shown to be efficacious, and use of opioids for management of renal colic should be minimized *(level 1, strong recommendation).*

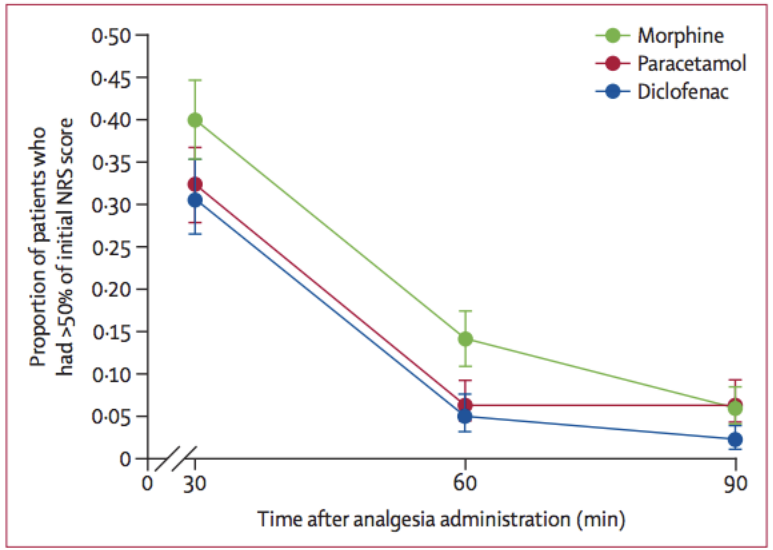


Figure 2: **Proportion of patients with ureteric calculi who did not achieve a significant pain reduction (≥50% reduction from initial pain score)**
NRS=Numerical pain Rating Scale score.

Conservative management

- Resolution of symptoms and patient-reported stone passage after renal colic *DO NOT* always confirm passage of an obstructing ureteral stone. **Followup imaging is recommended to confirm stone passage** *(level 3, strong recommendation).*

Table 2. *Performance assessment of PROs for determining successful SSP*

PRO (No. pts)	% Successful SSP	% Persistent Calculus	% Accuracy (95% CI)	% Sensitivity (95% CI)	% Specificity (95% CI)
Cessation of pain (129)	62.7	37.3	66.0 (59.2–72.4)	77.1 (67.9–84.8)	55.1 (45.2–64.8)
Reported stone passage (72)	80.5	19.4	71.2 (64.6–77.2)	55.2 (45.2–64.9)	86.9 (79.0–92.7)
Combination (59)*	79.7	20.3	67.0 (60.2–73.3)	44.8 (35.1–54.8)	88.8 (81.2–94.0)

Table 2. Stone passage by patient report and CT scan

	Passage by Scan	NO Passage by Scan	Relative Risk* (95% Confidence Interval)
Passage by report	91/97 (93.8)	6/97 (6.2)	1.30 (1.16–1.46)
NO passage by report	101/140 (72.1)	39/140 (27.9)	
All patients	192/237 (81.0)	45/237 (19.0)	

Data presented as n/N (%).
* Relative risk that patient reported passage corresponds to CT passage.

Shockwave lithotripsy (SWL)

- Stone size, location, composition, density, and skin-to-stone distance (SSD) can help counsel patients regarding the success rates of SWL treatment. Known uric acid, cystine, and brushite stones are likely best treated with ureteroscopy (URS) *(level 4, moderate recommendation)*.
- Patients with ureteral stones with a **density >1000 HU or SSD >10 cm have lower stone-free rates with SWL** *(level 2, strong recommendation)* and shared decision-making with patients is important to balance the availability, morbidity, and efficacy of SWL vs. URS.

Shockwave lithotripsy (SWL)

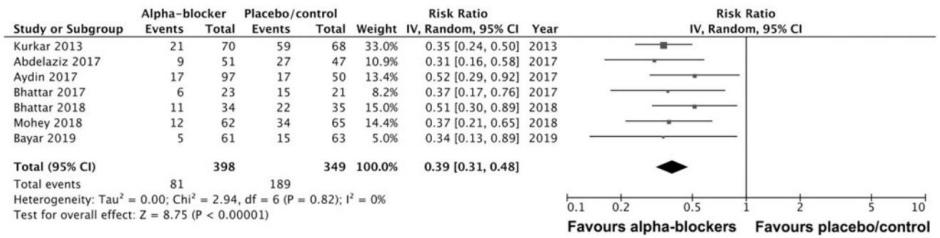
- Patients with upper ureteric stones >1 cm or those selected for re-treatment after initial failed SWL should be treated at a **rate <120 shocks/minutes for optimal fragmentation** *(level 1, strong recommendation).*
- If unsuccessful, repeat SWL can be considered but **>2 treatments to the same ureteric stone has little incremental benefit** and ureteroscopy should then be considered *(level 4, moderate recommendation).*

Shockwave lithotripsy (SWL)

- Alpha-blockers (e.g., tamsulosin) should be prescribed after SWL for ureteral stones to improve treatment success rates *(level 1, moderate recommendation).*
- Ureteral stents do not improve stone-free rates after SWL and do not reduce the risk of steinstrasse or infection following SWL for most patients (i.e., stones <2 cm) *(level 1, moderate recommendation)*.

Ureteroscopy (URS)

- **Preoperative alpha-blockers** may improve intraoperative and postoperative outcomes for patients undergoing URS; however, the optimal duration of preoperative alpha-blocker therapy is still uncertain *(level 1, moderate recommendation).*

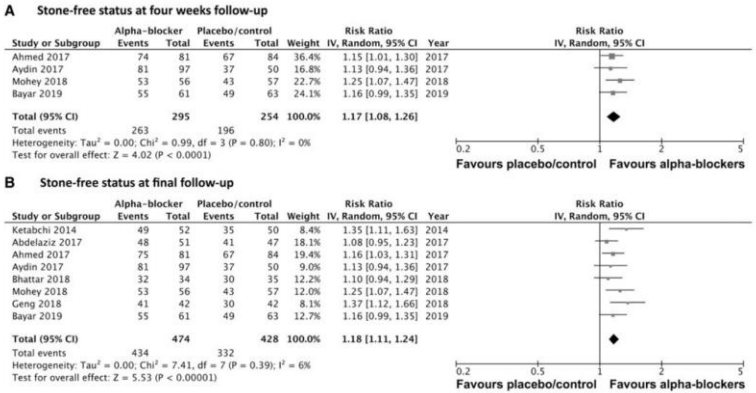


Study or Subgroup	Alpha-blocker Events	Total	Placebo/control Events	Total	Weight	Risk Ratio IV, Random, 95% CI	Year
Kurkar 2013	21	70	59	68	33.0%	0.35 [0.24, 0.50]	2013
Abdelaziz 2017	9	51	27	47	10.9%	0.31 [0.16, 0.58]	2017
Aydin 2017	17	97	17	50	13.4%	0.52 [0.29, 0.92]	2017
Bhattar 2017	6	23	15	21	8.2%	0.37 [0.17, 0.76]	2017
Bhattar 2018	11	34	22	35	15.0%	0.51 [0.30, 0.89]	2018
Mohey 2018	12	62	34	65	14.4%	0.37 [0.21, 0.65]	2018
Bayar 2019	5	61	15	63	5.0%	0.34 [0.13, 0.89]	2019
Total (95% CI)		**398**		**349**	**100.0%**	**0.39 [0.31, 0.48]**	
Total events	81		189				

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 2.94$, df = 6 (P = 0.82); $I^2 = 0\%$
Test for overall effect: Z = 8.75 (P < 0.00001)

Risk Ratio IV, Random, 95% CI
0.1 0.2 0.5 1 2 5 10
Favours alpha-blockers Favours placebo/control

FIG. 3. Forest plot for need for intraoperative ureteral dilatation.



A Stone-free status at four weeks follow-up

Study or Subgroup	Alpha-blocker Events	Total	Placebo/control Events	Total	Weight	Risk Ratio IV, Random, 95% CI	Year
Ahmed 2017	74	81	67	84	36.4%	1.15 [1.01, 1.30]	2017
Aydin 2017	81	97	37	50	16.8%	1.13 [0.94, 1.36]	2017
Mohey 2018	53	56	43	57	22.7%	1.25 [1.07, 1.47]	2018
Bayar 2019	55	61	49	63	24.1%	1.16 [0.99, 1.35]	2019
Total (95% CI)		**295**		**254**	**100.0%**	**1.17 [1.08, 1.26]**	
Total events	263		196				

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.99$, df = 3 (P = 0.80); $I^2 = 0\%$
Test for overall effect: Z = 4.02 (P < 0.0001)

Risk Ratio IV, Random, 95% CI
0.2 0.5 1 2 5
Favours placebo/control Favours alpha-blockers

B Stone-free status at final follow-up

Study or Subgroup	Alpha-blocker Events	Total	Placebo/control Events	Total	Weight	Risk Ratio IV, Random, 95% CI	Year
Ketabchi 2014	49	52	35	50	8.4%	1.35 [1.11, 1.63]	2014
Abdelaziz 2017	48	51	41	47	18.1%	1.08 [0.95, 1.23]	2017
Ahmed 2017	75	81	67	84	19.4%	1.16 [1.03, 1.31]	2017
Aydin 2017	81	97	37	50	9.0%	1.13 [0.94, 1.36]	2017
Bhattar 2018	32	34	30	35	12.2%	1.10 [0.94, 1.29]	2018
Mohey 2018	53	56	43	57	12.0%	1.25 [1.07, 1.47]	2018
Geng 2018	41	42	30	42	8.1%	1.37 [1.12, 1.66]	2018
Bayar 2019	55	61	49	63	12.7%	1.16 [0.99, 1.35]	2019
Total (95% CI)		**474**		**428**	**100.0%**	**1.18 [1.11, 1.24]**	
Total events	434		332				

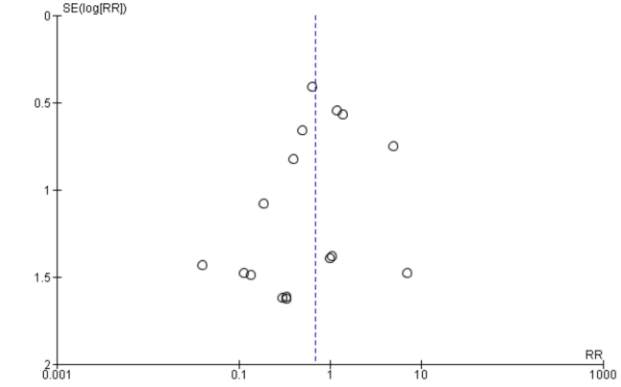
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 7.41$, df = 7 (P = 0.39); $I^2 = 6\%$
Test for overall effect: Z = 5.53 (P < 0.00001)

Risk Ratio IV, Random, 95% CI
0.2 0.5 1 2 5
Favours placebo/control Favours alpha-blockers

Ureteroscopy (URS)

- **Routine pre-URS stenting is not necessary** but may facilitate ureteral access sheaths (UAS) insertion and improve stone-free rates in patients with larger stones *(level 2, weak recommendation).*
- **Routine stenting after uncomplicated URS is likely unnecessary** *(level 2, strong recommendation)* but stent placement after UAS use is warranted *(level 3, weak recommendation).*

Figure 3. Funnel plot of comparison: 1 URS with stent placement vs URS with no stent placement, outcome: 1.1 Unplanned return visit to emergency/urgent care department.



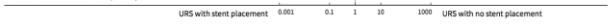
Analysis 1.11. Comparison 1 URS with stent placement vs URS with no stent placement, Outcome 11 Hospital admission.

Study or subgroup	URS with stent placement n/N	URS with no stent placement n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Başeskioğlu 2011	5/144	4/142		18.99%	1.23[0.34,4.5]
Benrabah 2014	0/100	0/100			Not estimable
Borboroglu 2001	0/53	4/54		6.22%	0.11[0.01,2.05]
Cevik 2010	0/30	0/30			Not estimable
Damiano 2004	0/52	12/52		6.59%	0.04[0,0.66]
Denstedt 2001	1/29	0/29		5.37%	3[0.13,70.74]
ElHarrech 2014	0/42	1/38		5.34%	0.3[0.01,7.21]
Ibrahim 2008	0/110	0/110			Not estimable
Isen 2008	1/21	1/22		6.97%	1.05[0.07,15.69]
Shao 2008	2/58	0/57		5.82%	4.92[0.24,100.18]
Sirithanaphol 2017	1/19	0/19		5.43%	3[0.13,69.31]
Wang 2009	1/71	5/67		10.2%	0.19[0.02,1.57]
Zaki 2011	12/99	13/99		29.08%	0.92[0.44,1.92]
Total (95% CI)	**828**	**819**		**100%**	**0.7[0.32,1.55]**

Total events: 23 (URS with stent placement), 40 (URS with no stent placement)

Heterogeneity: Tau^2=0.42; Chi^2=12.74, df=9(P=0.17); I^2=29.33%

Test for overall effect: Z=0.87(P=0.38)



Ureteroscopy (URS)

- Stent-related symptoms following URS may be ameliorated with alpha-blocker and/or anticholinergic medications *(level 2, moderate recommendation).*
- If access to the ureteral stone is complicated or impossible, placement of a stent and repeat URS is the safest option *(level 5, strong recommendation).*

Comparing shockwave lithotripsy (SWL) vs. ureteroscopy (URS)

- **SWL produces similar stone-free rates to URS for ureteral stones, albeit with a higher re-treatment rate and lower complication *rate*** *(level 1, strong recommendation).*
- While local/regional cost models need to be considered, SWL may be a more cost-effective option for ureteric stones *(level 4, weak recommendation).*
- Overall, there is similar patient satisfaction between SWL and URS for the treatment of ureteric calculi, but SWL has been found to have slightly better health-related quality of life outcomes, primarily from avoidance of a ureteral stent *(level 2, moderate recommendation).*

Special clinical scenarios – Anticoagulation

- Shockwave lithotripsy (SWL) and antegrade ureteroscopy (URS) are contraindicated in patients with uncorrected coagulopathies. When the risk of holding antiplatelet or anticoagulants outweigh the benefits, **proceeding with URS while a patient is anticoagulated is an acceptable option** *(level 2, moderate recommendation).*

Special clinical scenarios – Pediatrics

- Ultrasound is the first-line diagnostic modality used in children with suspected ureteral stones. This may be coupled with a kidney-bladder-ureter X-ray to increase accuracy. Low-dose non-contrast computed tomography may be used in certain situations *(level 3, strong recommendation).*
- A trial of passage with/without medical expulsive therapy is recommended for children with smaller (<5 mm) stones *(level 2, strong recommendation).*
- **Shockwave lithotripsy is a safe and effective option for ureteral stones in children** *(level 2, strong recommendation).*

Special clinical scenarios – Pregnancy

- First-line diagnostic testing for stones in pregnancy is ultrasound, but low-dose non-contrast computed tomography or magnetic resonance imaging can also be used *(level 3, strong recommendation).*
- Obstructing ureteral stones can be managed conservatively in pregnancy, in the absence of suspected or confirmed urinary tract infection *(level 3, moderate recommendation).*
- Ureteroscopy with laser lithotripsy is safe in pregnancy*, however, shockwave lithotripsy is contraindicated *(level 2, strong recommendation).*

**No "safest" trimester*